BioE 11 Midterm 1 – Spring 2019

Number of pages: 8 (including this one!)

SOLUTIONS

Last name: _____

First name: _____

Student ID No. (SID): _____

Important note:

This exam will be graded using gradescope. Any answers written outside the designated response areas will therefore not be graded. You can use the backside of the exam as scratch paper.

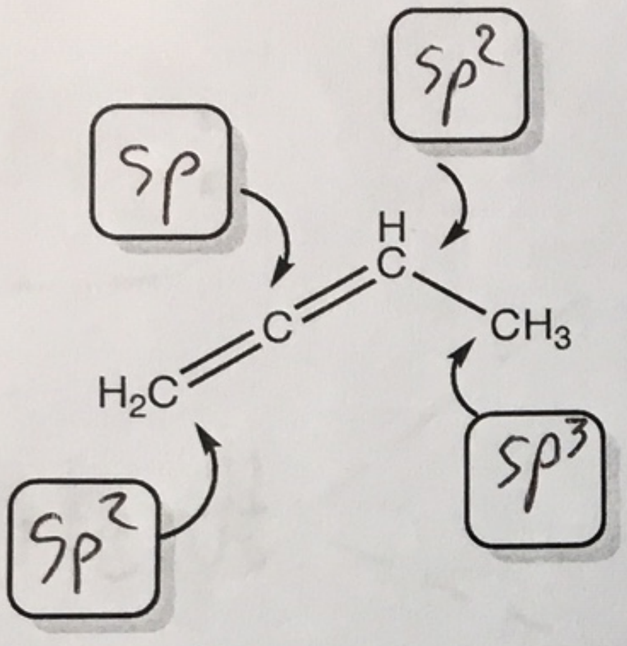
Last/First Name:

BioE 11 - Midterm 1 - 2/28/2019

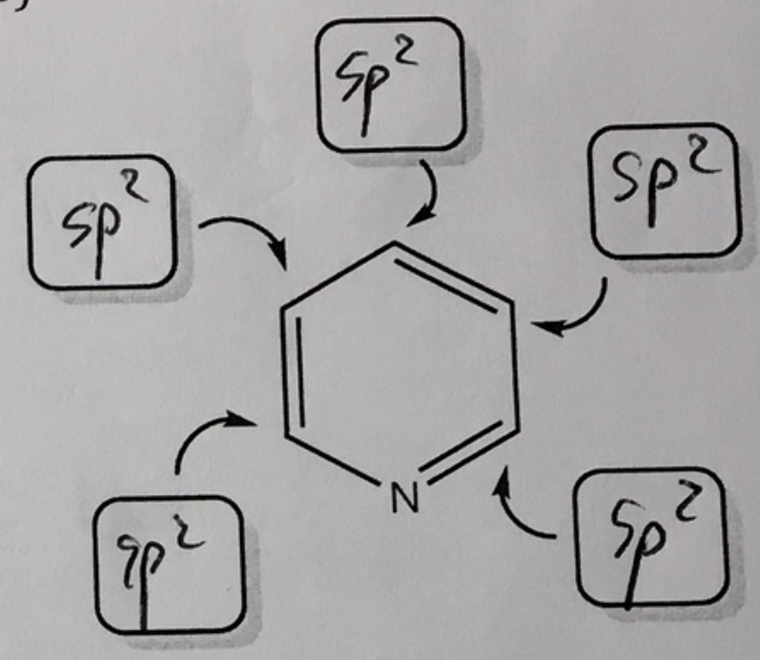
0.43p/box

Question 1: State the hybridizations of the carbons below. Write in the provided boxes.

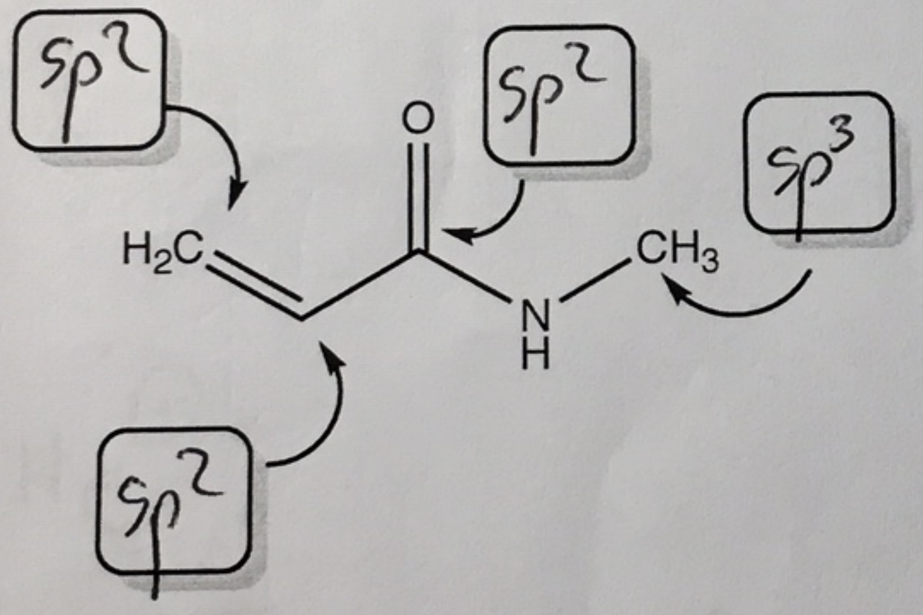
a)



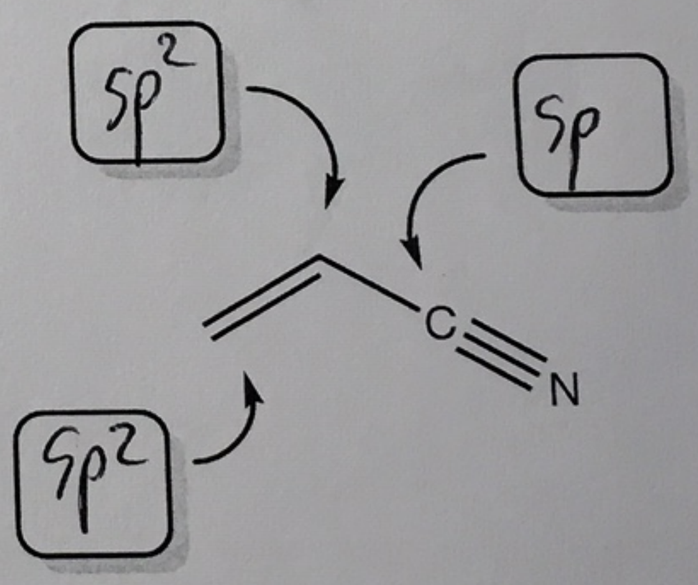
b)



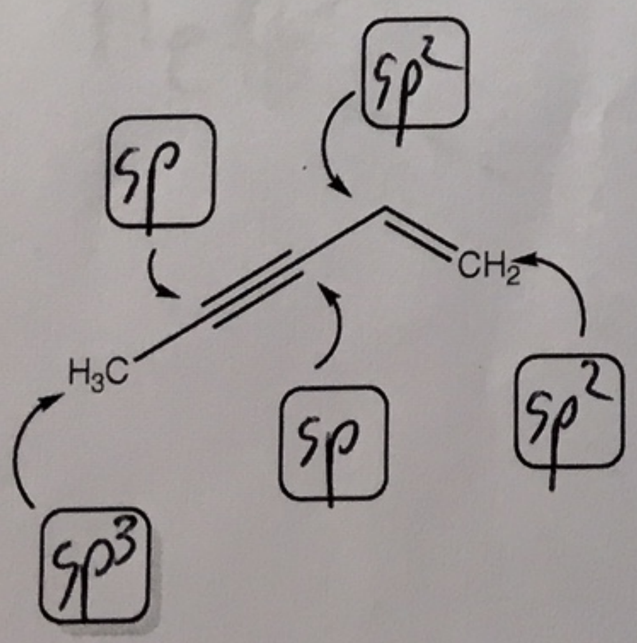
c)



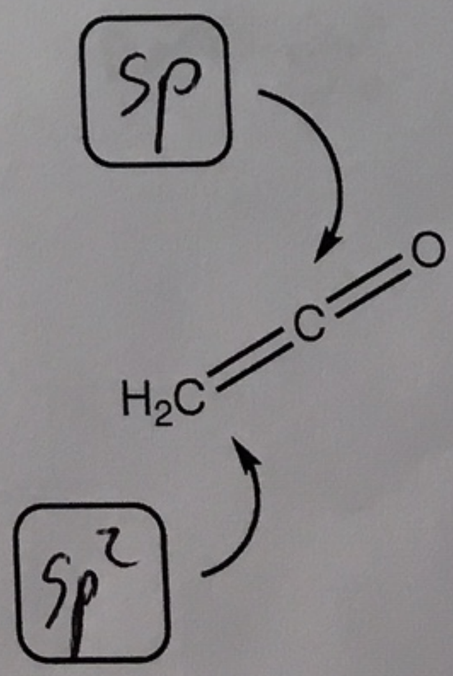
d)



e)



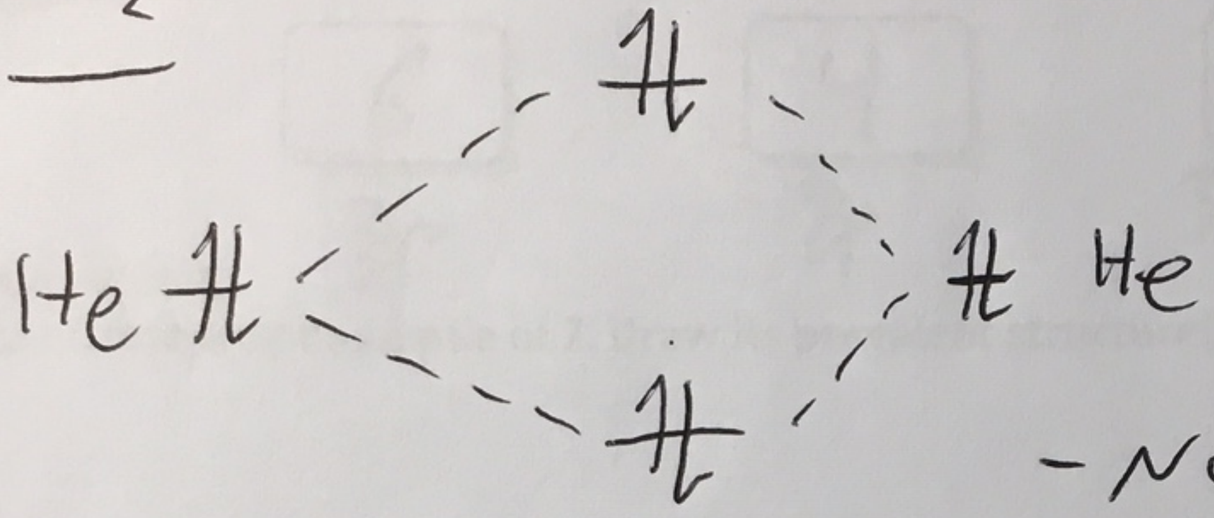
f)



Last/First Name:

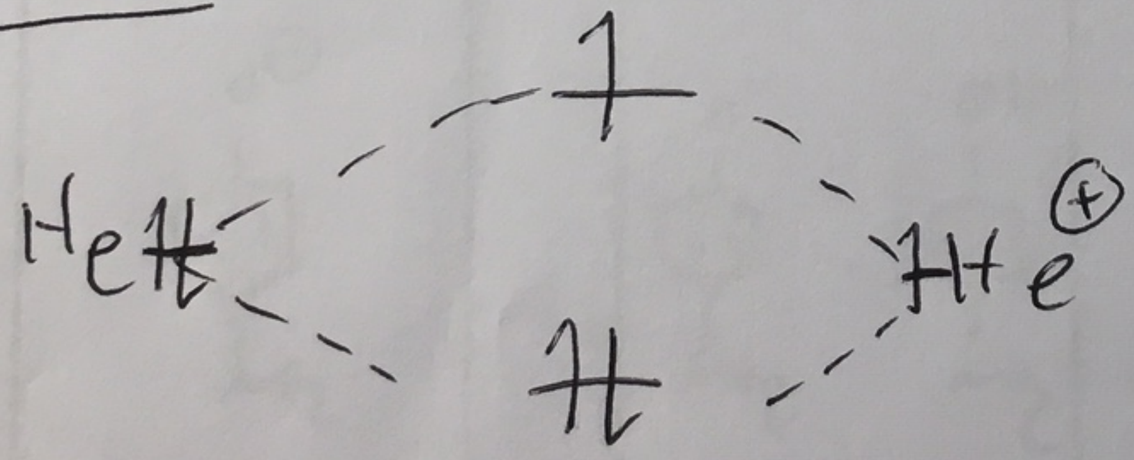
Question 2: The Helium He_2^+ cation exists, whereas the neutral He_2 does not. Explain why this is using a molecular orbital diagram. (Helium's atomic number is 2). Respond in the box below.

σ_s^*: He_2



– NO ENERGETIC BENEFIT.

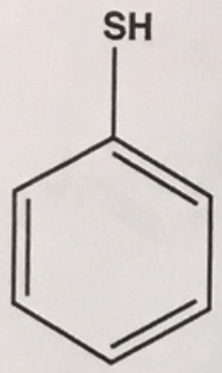
σ_s: He_2^+



– OVERALL LOWER ENERGY.

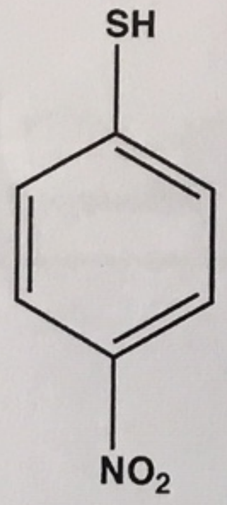
Last/First Name:

Question 3: The compounds below have pKa values of 6, 8.6 and 4. Assign these pKa values to the compounds below.



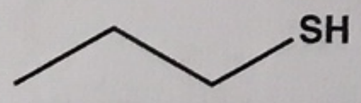
6

3p



4

3p

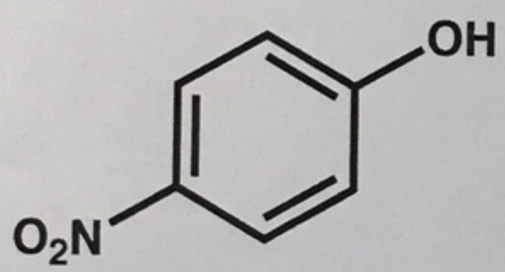


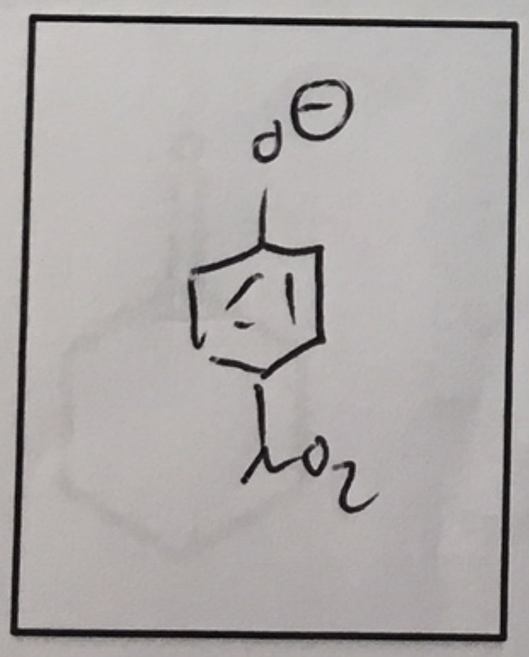
8.6

3.3p

Question 4:
p-nitrophenol has a pKa of 7. Draw its prevalent structure(s) at pH 10, 7 and 4.

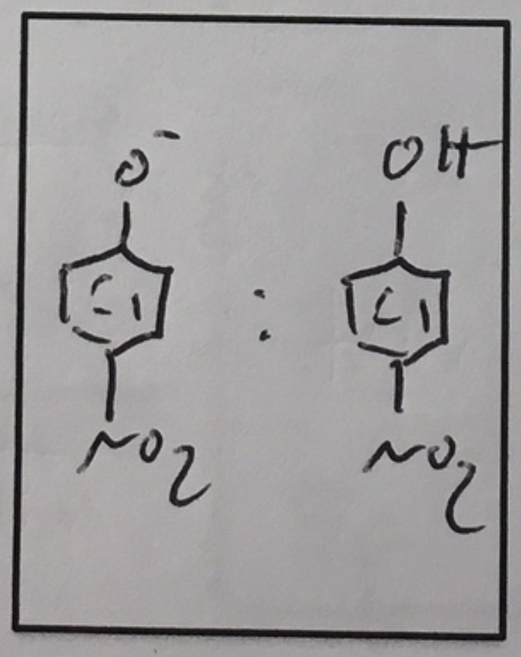
Nitrophenol:





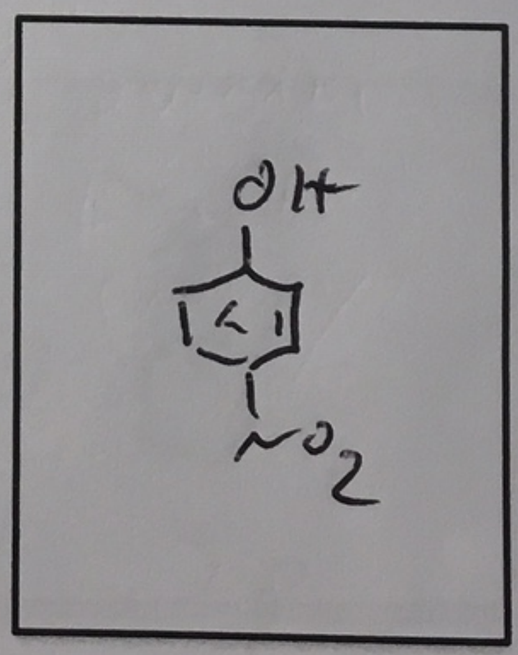
pH 10

3p



pH 7

4p



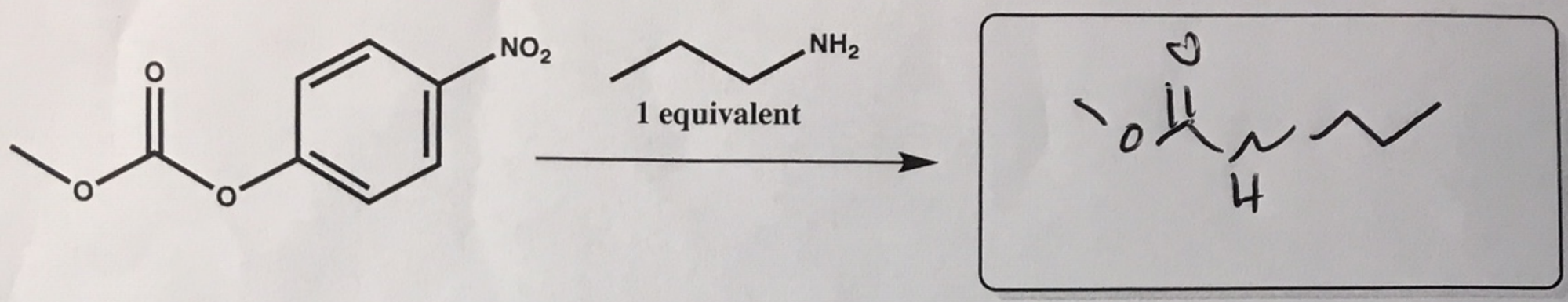
pH 4

3p

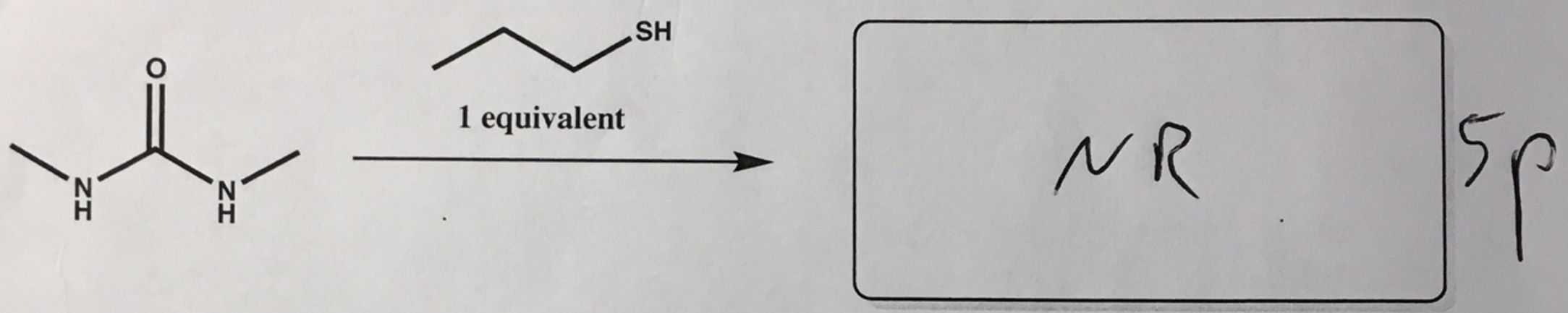
Last/First Name:

Question 5: Predict the product(s) for these reactions. *In the case of no reaction, mark with NR.*

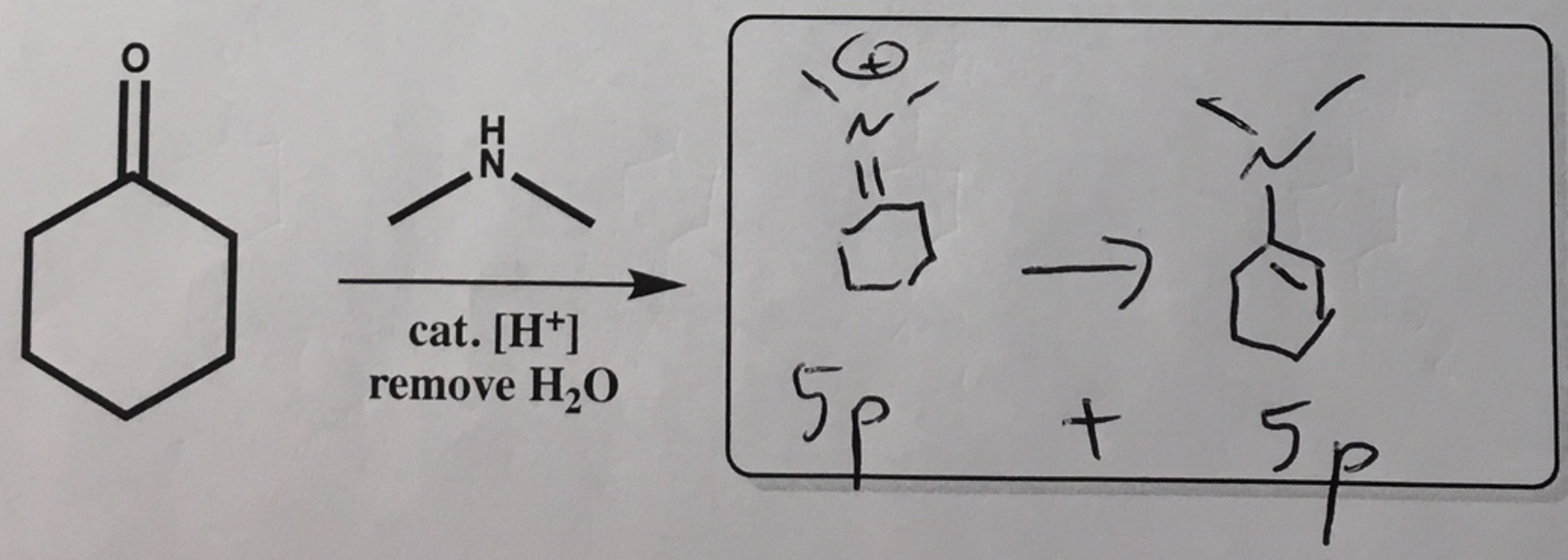
a)



b)

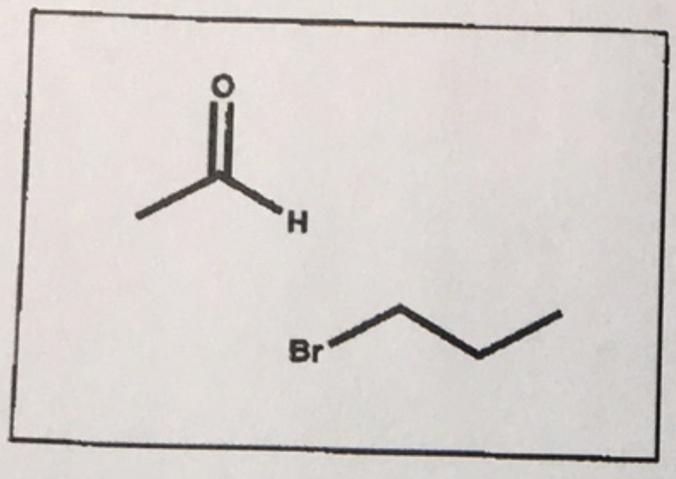


Question 6: Predict the product of the following reaction:

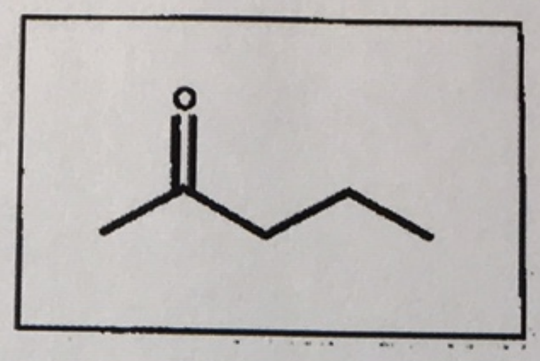


Last/First Name:

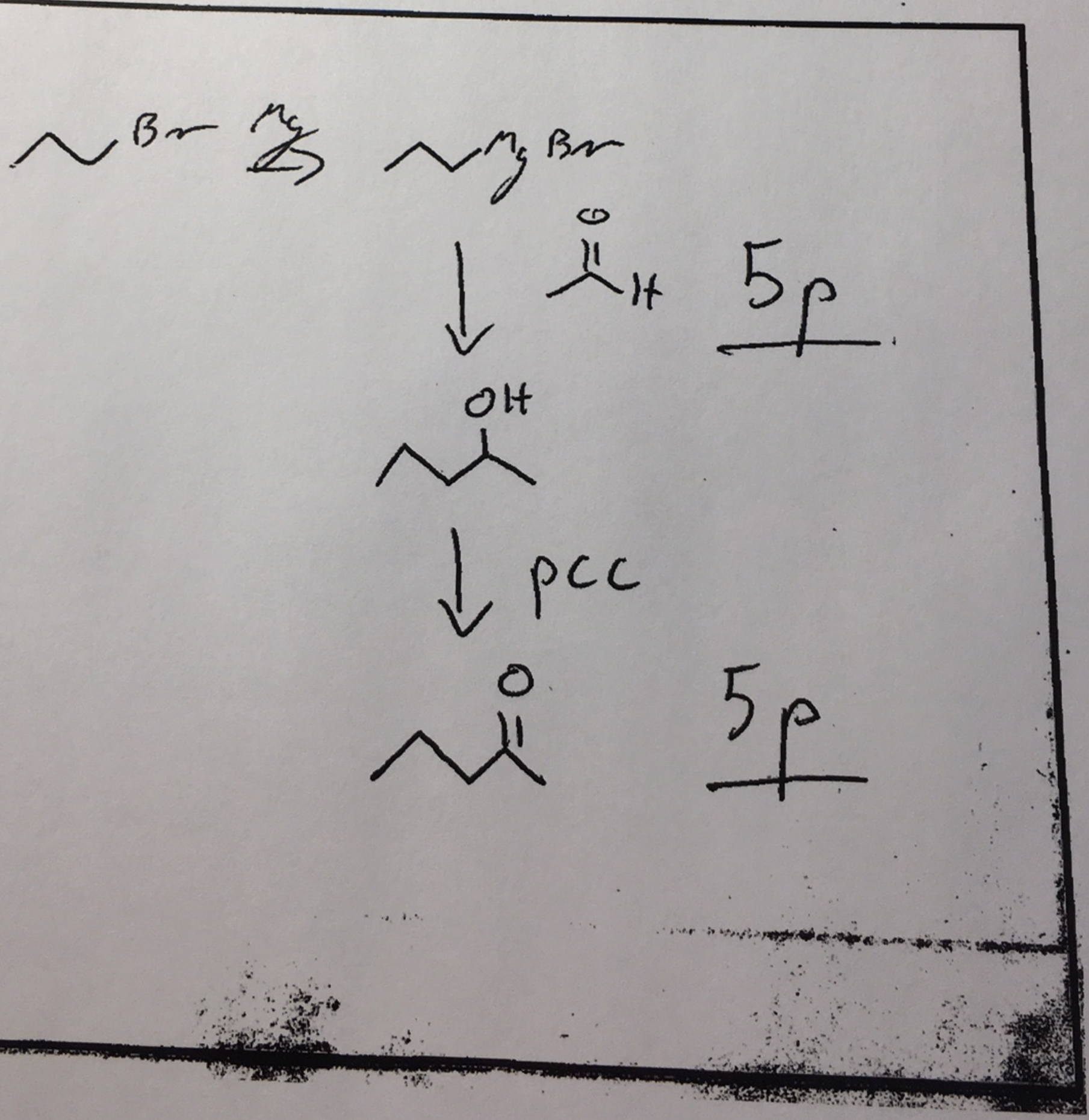
Question 7: Propose a synthesis for the product drawn below using the listed reactants. You will also need some additional basic reactants. Please make it clear which additional reagents you use.



Reactants



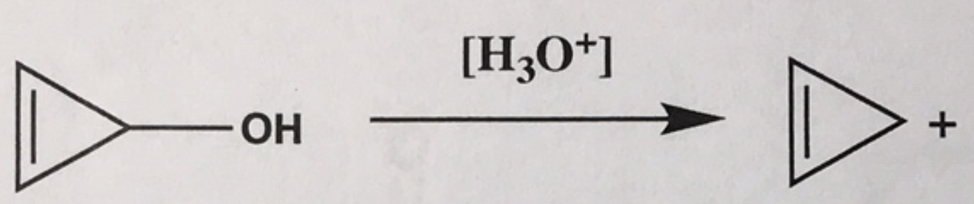
Product



Last/First Name:

Question 8:

a) How many pi electrons are in the conjugated system of the *cyclopropene cation* which is formed under the following conditions:



4p Answer: 2

b) Is the *cyclopropene cation* aromatic? (Y/N)

3p Answer: Y

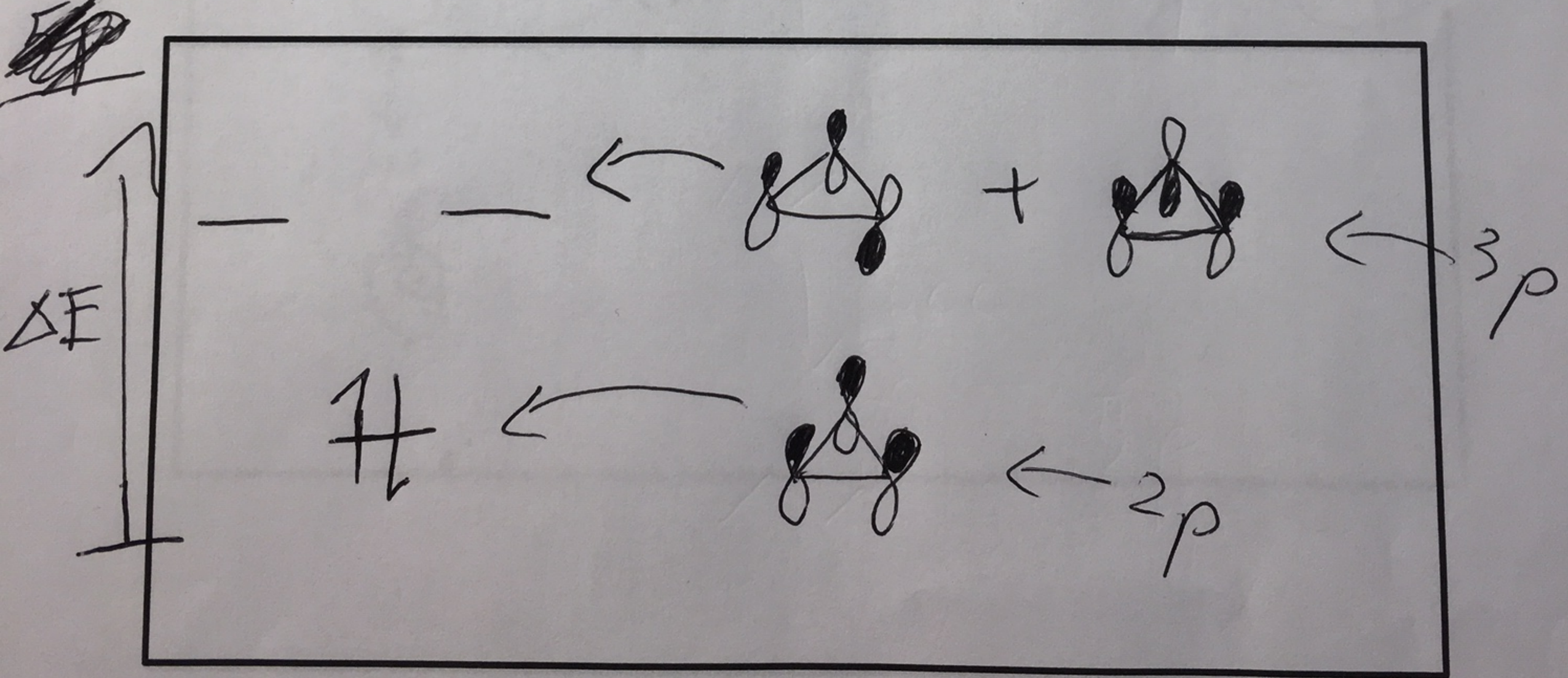
c) Is the *cyclopropene alcohol* aromatic? (Y/N)

3p Answer: N

Extra credit:

Draw the molecular orbitals of the pi system in the cyclopropene cation.

5p



Last/First Name:

Question 9: One of the protons H_a and H_b has a chemical shift of 6.0ppm, and the other is 7.0ppm. Please assign the correct shift values to H_a and H_b and explain your reasoning using a figure and 1-2 sentences.